COST ESTIMATES OF SIMULATED CHANGES IN LINER SHIPPING SERVICES

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ABSTRACT: *A number of analysts have suggested that shipping conferences operate their services with a higher level of excess capacity and with a more inflated cost structure than would exist with a more competitive liner market. The paper estimates the loss in allocative efficiency associated with several potential sources of conference inefficiency by simulating a series of service optima and comparing the implied costs with estimates of actual costs. The findings suggest that a greater amount of price and service competition among liner operators may result in welfare gains, but in none of the cases analysed is the gain likely to be substantial.*

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LINER COST SIMULATIONS

INTRODUCTION

"Revitalisation" of transport regulation was swept forward on a wave of enthusiasm in the late 1950s and early 1960s. It was particularly prominent in the US following the Kennedy Administration's announcement (1) that new regulations would place greater reliance on the forces of competition and less emphasis on the restraints of regulation. The main thrust of the recommendation was to free competition by removing the regulatory control over minimum rates. The quid pro quo of the proposal was the promise of a more sustained effort to curb monopolies and predatory trade practices through antitrust laws. The legacy of the period is significant in two separate but related ways. First, it gave official recognition to pockets of competition within a regulated industry which were previously viewed as opportunistic exploitations of the regulatory system.(2) Second, it implicity conveyed a preference for judicial regulation rather than administrative rulings by statutory authorities.

By the late 1960s the emphasis was changed to "regulatory reform". It followed a period of questioning the accomplishments of the existing regulatory framework. The answers, which were generally unfavourable to the existing regulatory process, are valuable in isolating the perceived function of government intervention. The role of the regulator was conceived as one of maintaining the framework of the free market, of enforcing and supplementing competition and removing its imperfections - not supplanting it. A large number of case studies (3) revealed that competition was effectively fettered, and while informed opinion continued to maintain that regulation had a purpose, it was generally agreed that the purpose was incompletely served. The legacy of the 1960s was a coherent definition of the regulatory dilemma, (4) which stimulated a search for methods of escape.

A combination of impatience and some startling estimates of the misallocative effects of regulation (5) during the early 1970s produced a trend toward "deregulation". The intention was made clear by the unequivocal prefix denoting a reversal, rather than a simple change in direction.

Unfortunately, it raised more questions than it answered. Are economic processes reversible? Was the regulatory system so corrupted and

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(1) "Presidental Message on Transportation", to Congress, dated April 4, 1962.

(2) Contrast the Kennedy report with the one released seven years earlier by the (Eisenhower) Presidential Advisory Committee on Transport Policy and Organisation (1956).

(3) See Kahn (1971) and the extensive literature cited therein.

(4) "If the decision to regulate were nothing more than a decision that competition was in some way or other inadequate to serve the public interest, and if regulation itself merely supplemented such competition as prevailed, there would still be problems but there would be no general regulatory dilemma. The general dilemma arises from the fact the decision to regulate is, typically, a decision also to restrict competition, not just to supplement it in one way or another, but to supplant it" (Kahn 1970, p.1).

(5) Peck (1965) and Friedlaender (1969) concentrate on freight transport. Civil Aeronautics Board (1975), summarises the research into passenger air travel.

calcified that it was beyond redemption? What do we do and where do we go if the reversal is incomplete or inadequate? While some of these questions have been examined, (1) it is clear that much more thought and analysis is needed.

The progression in regulatory thinking from a revitalisation of regulation to its reformation and then its reversal was not the product of a current fad. It evolved from careful consideration of pressing and perplexing issues. Proposed solutions may nevertheless generate their own momentum and overstep their original bounds, or overstate their basic functions. Through haste or overzealousness, a number of minor but troublesome issues may become lost. These "molehills" constitute minor bumps compared with the more lofty issues, but an accumulation of minor facts and arguments may ultimately make one policy alternative appear slightly less undesirable than it otherwise would. The purpose of this paper is to examine a few "bumps" associated with liner shipping.

SCOPE OF THE ANALYSIS

The general approach does not differ substantially from earlier studies. Following Harbeson (1969) the misallocative effects of the non-competitive market are analysed. There are differences in procedure, however. As noted by Levine(1978), previous studies of regulatory misallocation were based upon a calculation of the cost of providing the transport service as a function of distance. Freight costs were adjusted for various quality-of-service differences between the actual and the optimal allocation of traffic, which is inferred from the least-cost service arrangement. Within a series of distance-blocks, the welfare loss was obtained from the difference between the adjusted actual cost and the marginal cost of the optimal service, multiplied by the quantity of diverted traffic. Adding up the loss for all distance-blocks gives the total welfare loss from rate regulation.

Unfortunately liner shipping does not fit easily into such a scheme. Competition with bulk shipping is independent of distance. It is influenced primarily by the shippers' ability to transport shipload consignments and by the physical characteristics of the commodity.(2) A secondary requirement is the shippers' ability and willingness to accept the legal and financial commitment under the terms of the charterparty.(3) Similarly, competition between conference members and independent liner operators is unaffected by distance. Independents generally offer a more restricted service (less frequent and/or fewer ports) and are likely to concentrate on obtaining cargo from a subset of conference shippers.(4)

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(1) A partial list includes Friedlaender and Spady (1981), Levine (1981b) and Winston (1981).

(2) The commodity must be homogeneous and must be amenable to mechanised bulk handling methods.

(3) In liner operations almost all of the risk is carried by the shipowner. The shipper is offered a regular service at a fixed rate and is free to choose the amount of service required at any given time.

(4) A profit maximising independent may be expected to seek eventually the high-rated cargo and neglect entirely the low-rated items. Upon entry, however, cargo rated close to the average is an appealing target since (1) the conference is less likely to react defensively, and (2) the cargo provides a secure base upon which service reliability can be established. For an analysis of FESCO's pricing policies as an independent in US trades, see Ellsworth (1981).

Neither of the two competitive influences can be judged optimal relative to conference operations, (1) and diverted cargo is limited to that which is captured by the conference tying arrangements. (2)

The basic approach of the earlier work can nevertheless be retained by defining a series of simulated changes in the liner service, each of which is indicative of a partial or limited optimum. Cost differences can then be estimated and evaluated in a more qualitative manner. It will not provide a direct measure of welfare loss, but it will give an approximate idea of the range within which the true loss is likely to be contained. The procedure has several advantages over the more conventional method. First, since only the extreme values of welfare gains and losses are sought, it is not necessary to defend the simulated changes as being practical; they may merely be possible. Second, it permits cost comparisons with a variety of alternative arrangements, rather than the more typical selection of a perfectly competitive market. Third, the accuracy of the estimates is less crucial. However, in order to evaluate the cost comparisons it is necessary to be specific about the type of regulation the effects of which are being estimated.

THE REGULATED LINER INDUSTRY

On the basis of Pegrum's three meanings of the term "regulation of business", (3) the liner industry is virtually unregulated. Conferences are generally exempt from trade practices legislation, (4) and no government exerts direct control over conference prices or conditions of entry. (5)

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(1) In principle it would be possible to model the shipper's ability to choose between conference members and independents as a modal choice problem in a way similar to Levine's(1981a). There would, however, be substantial data problems. Market shares of specific commodities, for example, are unavailable.

(2) It is impossible to estimate the amount of cargo which would be given to independents if the dual rate contracts were prohibited.

(3) Pegrum (1965, p. 253) lists : (1) all rules of business conduct prescribed by the state, (2) legislative action designed to limit the freedom of activity of business enterprise (e.g. antimonopoly legislation), and (3) positive control by public bodies over prices, profits, entry or discrimination.

(4) Many national governments prohibit certain "unfair" practices such as "fighting ships", deferred rebates, and unreasonable discrimination, but these practices are substantially less limiting than the complete list of typical restrictive trade practices. Refer to Department of Transport [Grigor Report](1977), especially Chapters 4 and 5.

(5) The US is regarded as having the most fully regulated private sector, but even there,liner shipping is relatively uncontrolled. The Federal Maritime Commission is specifically denied the opportunity of restricting entry into conferences and may not permit conferences to restrict membership in any way. Moreover, the Commission has minimal ratemaking powers over foreign commerce. (See US Department of Justice (1977), p.47). With no control over price or supply, there is no market control. The most the Commission can do under the Shipping Act of 1916 is to enforce the "common law duties" of liner operators by insisting that they provide a regular and reliable service to all who wish to use it, without discrimination and at "reasonable" rates.

While the notion that regulation arises solely from statute law is widely held, it has an obvious weakness in that it neglects entirely the relevance of common law, the implicit regulations that form a system of morality and ethics and the private sector regulations associated with corporations, trade unions, trade associations, cartels and professional associations. The various forms of regulation have caused much confusion in the recent literature. Fortunately, a few writers such as Reynolds (1981) have attempted to clarify the matter.

Liner shipping is regulated, but the regulations are predominantly private, rather than public, and have generally been implicit, rather than explicit. It is one of the few industries for which this is true and such an anomaly arose partly from the peculiar circumstances of the early conferences and partly from their ability to adjust to changing conditions. Background material in Deakin (1973) and von Schriach-Szmigiel (1979) is useful in assessing the unique aspects of liner shipping.

The private regulation of conferences is fundamentally an instrument for the removal of price competition in the marketplace by an agreement to maintain a common tariff. The aim is to substitute concerted or unified control of the market for the hazards and insecurity of competitive enterprise.(1) When a common tariff is insufficient to remove the major elements of risk, conferences typically institute an allotment of shipping capacity, a revenue or a cargo pool. The precise form of the regulation depends upon the conditions prevailing in the trade and the laws of the countries involved.

A misallocation of resources will occur if the agreed-upon rates are higher than those which would otherwise remain in effect. If a conference is able to restrict supply, the case is straightforward and monopoly profits are presumed. Otherwise, higher prices may occur through a failure to minimise costs, either by over-employing one or more input factors or by over-paying them. In either case, the absence of market forces, permits the sub-optimal conditions to be perpetuated.

No evidence has been found to suggest that conferences earn monopoly profits. The rate of return on investment, as reported, is not high. (2) Moreover, conferences have been more frequently subjected to arguments that they chronically oversupply. (3) Hence, the main thrust of the anti-conference attitude is one of waste through technical inefficiency and a restricted choice of a price/quality-of-service combination. We propose to examine three aspects of the argument. First, is spare capacity excessively high and if so, what are the costs? Second, can input prices be reduced through greater competition (less conference control)? Third, do economies of scale prevent a more allocatively efficient choice of service quality?

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(1) Stocking and Watkins (1948, p.5), note that without exception all cartels reflect that aim.

(2) The most extensive study was reported by Deakin (1973).

(3) See especially Devanney (1975).

SIMULATION 1 : CONSISTENTLY HIGH CAPACITY UTILISATION

Introduction

Oversupply frequently occurs in regulated markets. If the rate exceeds the equilibrium level, some buyers will be rationed out of the market and sellers will offer more of the product or service than can be sold at that price. If there are no incentives to adjust the scale of production, the industry will be chronically oversupplied. Normally such an incentive exists through profit maximisation. Each supplier can cut costs by disinvesting, or by refusing to renew equipment when it wears out, and thereby realise greater profits. This fundamental part of the adjustment process may be circumvented, however, in a regulated environment.

First, the existence of abnormally high profits may interfere with the ability of the sellers to sustain or defend the higher rates. This applies whether the rate is set by a regulatory authority or by consultation and negotiation with buyers and their representatives. The ability is less restrained (or not restrained at all) in the case of a monopolist who raises prices by restricting supply. (1)

Second, spare capacity is frequently used as a defensive tool in a market which is not perfectly competitive. It may be used as a barrier to new entry, or for existing suppliers, a reduction in price by one supplier for the purpose of acquiring a greater market share (or for preserving the existing market share) will necessarily be followed by an increase in the quantity sold. If spare capacity exists, then the increase can be achieved with modest increases in cost.

Third, in a partially cartelised market (without pooling) each supplier can usually gain by offering more of the service at the existing price, especially if the offer is treated as an improvement in quality. A liner operator, for example, can increase the frequency of sailings or visit a larger number of ports, and thus reduce the shipper's costs of time-in-transit, storage or inland transport. Such changes add to total capacity and to operating costs and will be preferred by shippers if it entails no additions to the freight rate, relative to that which is charged by other suppliers with a lower quality of service.

The desirability of a regularly scheduled service at rates which are fixed in the short run is incompatible with a market which has neither excess demand nor excess supply. Fluctuations in demand are certain to occur, and if neither the price nor the available capacity can be altered to meet the fluctuations, it is also certain that either buyers or sellers will be temporally unsatisfied. In liner shipping, the economic and institutional arrangements require that the shipowners must err on the side of excess cargo space more frequently than the converse. (2) Such an arrangement obviously adds to costs and therefore to freight rates The relevant questions are how much of the excess capacity may be attributed to factors outside the shipowner's control and what is the cost of the excess?

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(1) A discussion of cartels versus monopolies is found in Devanney (1975).

(2) See Zerby and Conlon (1978).

Both questions are examined by simulating a liner service in which all vessels are loaded to 90 per cent of their maximum deadweight capacity. (1) The productivity of ships and terminal facilities, as well as the rates of payment to input factors, are assumed to be constant at the higher level of vessel utilisation. It is assumed that such a service arrangement is possible so that cost differences can be calculated.

Data

The data for productivity and operating costs are obtained from an earlier study of Australia's exports of wool to Europe. (2) They apply to the 1974-75 period which unfortunately is no longer representative of either productivity or costs. It remains, however, the most recent data giving a useful breakdown into separate components. An attempt is made in the final section of this paper to evaluate the estimates in terms of more recent conditions. The differences do not appear to be crucial to the major conclusions.

Seasonal trade patterns constitute an important source of variation in liner utilisation rates. Monthly shipments of exports and imports shown in Table 1 indicate that substantial stocks of cargo must be maintained in order to even out the peaks and troughs of trade flows. The average buffer stock required is 43,197 tonnes per month for Australia's exports by 11 Australia-to-Europe Conference vessels, and 27,745 tonnes for imports. The maximum for the former is 71,351 in October, compared to 67,899 tonnes in August for imports. We shall examine both imports and exports, and assume initially that a mixture of general cargo is held as a buffer.

During 1974-75, the vessels made 45 round voyages and carried 661,568 tonnes of exports. The average time for a complete voyage was 85.029 days and operating costs at sea were $20,500. The costs per day in port were substantially less, owing to the saving in fuel. Since 727,530 tonnes of cargo were imported from Europe during the year, it is necessary to assume that a portion of that cargo is carried by other vessels when the service is altered to suit the requirement of 90 per cent utilisation for Australian outward journeys.

Estimates of Cost Differences

Since time at sea is assumed to be unchanged, the total voyage time (including time in port) must be increased in order to fill each vessel to 20,790 tonnes deadweight, which is 90 percent of cargo capacity for the vessels analysed. This will add 7.13 days to the voyage. With an average value of liner cargo in the trade of about $1,000 (3) per tonne in 1974-75,

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(1) This assumes that the volume constraint is not operative. The assumption is reasonable for Australia's exports during the period investigated.

(2) Zerby, Conlon and Kaye (1976).

(3) The average value per tonne of all exports examined in Zerby, Conlon and Kaye (1976) was $734. A weighted average would be higher since wool was valued at $2,077 per tonne and meat at $1,174 per tonne. The figure of $1,000 represents a rough approximation.

and with an assumed 12 per cent per annum cost of holding the cargo, each day's delay in transit will cost in excess of $13,670 per day per voyage. Finally, with a new voyage time of 93.16 days and with 31.18 voyages required to carry the year's tonnage, 13.18 voyages may be dropped and 8.13 vessels may be used. The calculations in Table 2 show that approximately $11.73 per tonne in direct transport costs could be saved by meeting the requirements of the simulated change.

The cost of the buffer stock can be estimated from the 1973-74 warehousing cost for wool of slightly less than 3¢ per kilo (1) or $2.50 per tonne per month. The figure is likely to overstate the cost associated with general cargo since it is based upon warehousing functions which are not fully duplicated with other commodities, but increases in handling charges between 1973-74 and 1974-75 will absorb part of the difference. The resulting cost of $2,128,290 therefore represents an approximate cost applied to both imports and exports. Finally, the opportunity cost of holding the buffer stock using a rate of 12 per cent per annum and a value of $1,000 per tonne is $8,513,040. These combined costs reduce the estimated savings to $3.69 per tonne which represents about four per cent of the freight rate on major exported commodities to Europe in that year.

The estimated costs of the buffer stock are more approximate than the estimates of the direct transport costs, and they are also highly sensitive to the choice of cargo used as a buffer. For example, since the value of wool is substantially greater than the assumed value, exclusive use of that commodity as a buffer stock would result in a net loss of $4 million for the simulation. In contrast, the exclusive use of mineral sands in containers, which were valued at only $96 per tonne in 1973-74, would yield a net gain of $13.5 million. Obviously the difference is substantial.

Two additional complications tend to reduce the possible gains from the simulation and make its implementation less practical. Some shippers may experience extremely high costs of shipping delays owing to their failure to meet delivery dates. For example, fresh apples and pears are shipped to Europe when locally produced fruit is unavailable. If they fail to arrive when the off-season demand reaches its peak, the price at which they are sold may be significantly lower. Additionally, reliance upon low-valued commodities as a buffer stock may cause problems in achieving an optimum balance in cargo weight and volume. Since low-valued items tend to be relatively dense, their containers are likely to weigh more than average. Such containers, if there are many of them, must be placed at or below the water line in order to maintain vessel stability. Unlike standby passengers, therefore, heavy buffer cargo must be loaded first rather than last. Neither problem is serious, but each would make the task of eliminating excess capacity more difficult and more costly.

Evaluation

A considerable amount of excess capacity existed in the Australia-Europe trade during the period studied. If all of the excess could be attributed to conference pricing policies and service arrangements, and if

(1) Zerby, Conlon and Kaye (1976, p. 54).

TABLE 1

MONTHLY SHIPMENTS OF CARGO ON SELECTED VESSELS

1974-75

MONTH (a)	TONNES LOADED	ACCUMULATED TONNES OF STOCK CARGO (b)	TONNES DISCHARGED	ACCUMULATED TONNES OF STOCK CARGO
JULY	29,243	25,887	19,437	41,190
AUG.	35,883	45,135	33,919	67,899
SEPT.	32,814	67,451	77,172	51,354
OCT.	51,229	71,353	69,259	42,723
NOV.	70,731	55,752	87,142	16,208
DEC.	48,619	62,264	52,457	24,379
JAN.	63,450	53,944	62,310	22,696
FEB.	69,630	39,444	78,781	4,543
MARCH	45,362	49,213	48,947	16,224
APRIL	71,017	33,326	63,706	13,145
MAY	73,833	14,624	71,198	2,574
JUNE	69,754	0	63,202	0
(Average)	(55,130.4)	(43,197)	(60,627.5)	(27,745)

Source : Zerby, Conlon and Kaye (1976)

Notes : a. Calculations assume that no stocks of cargo accumulate into the next financial year, so that "available" capacity per month is equal to the monthly averages shown in brackets at the bottom of the columns headed tonnes loaded and tonnes discharged.

b. Accumulated tonnes = "available" capacity per month minus tonnes loaded per month during 1974-75 plus accumulated stock from the previous month.

SELS

NES RGED	ACCUMULATED TONNES OF STOCK CARGO
7	41,190
9	67,899
2	51,354
9	42,723
2	16,208
7	24,379
0	22,696
1	4,543
7	16,224
6	13,145
8	2,574
2	0
7.5)	(27,745)

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TABLE 2

ESTIMATED TRANSPORT COSTS FOR

90 PER CENT CAPACITY UTILISATION

ON ALL AUSTRALIA-OUTWARD VOYAGES

(excludes additional costs for buffer stocks)

ADD		
Additional tonnes loaded in Australian ports per voyage	6088.60	
Additional days in Australian ports	4.70	
@ $11,041 per day x 31.82 voyages		$1,651,226
Additional tonnes discharged in European ports per voyage	6088.60	
Additional days in European ports	2.43	
@ $11,041 per day x 31.82 voyages		$ 853,719
Additional days for round voyage	7.13	
@ $13,670 per day (time-in-transit) x 31.82 voyages		$3,101,434
SUBTRACT		
Number of reduced voyages	13.18	
@ $1,602,873 per voyage		$21,125,865
		$15,519,486
NET GAIN		
PER TONNE OF ASSUMED CARGO (exports and imports)		$11.73

the entire amount could be eliminated in a more competitive market (with the size and type of vessels currently employed), the estimated net gain based upon stocks of average cargo would be $3.69 per tonne. With stocks of low-valued cargo the saving could be at most $9.50 per tonne (or 11 per cent of the average northbound freight rate) and with high-valued cargo the estimated loss is $3.25 per tonne. With stocks of cargo valued in excess of $1,573 per tonne, a net gain is unlikely.

In addition, it is clear from the results of the simulation that shippers of high-value commodities would oppose efforts to reduce excess capacity if it entailed an increase in transit time. Such shippers would experience substantial losses from a less frequent, less direct and slower service, and are therefore willing to pay a higher freight rate relative to the rate on low-value cargo. A rate in excess of costs undoubtedly contributes to inter-firm rivalry for the more expensive cargo, causing the quality of service to be biased in favour of those shippers, but the result is more attributable to competitive influences, than to the influence of monopoly. (1) Therefore, a highly competitive market would probably not succeed in eliminating all or even most of the excess capacity in liner shipping. A belief that the virtues of competition will override the self-interest of cartels provides the only rationale for the conclusion that a more competitive market will improve the status quo. However, from the estimates obtained here, gains from these sources alone may not be substantial.

SIMULATION 2 : REDUCTION OF INPUT COSTS

Introduction

Attention is frequently focused upon excessive administration costs of conference members. Earlier work by Ferguson (1961) and Devanney (1975) estimated that expenses for fleet administration were 10 per cent of gross revenues. For many trades, therefore, these shoreside operating costs contributed in excess of $8 per tonne to the freight rate. On the basis

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(1) Recent discussions of value-of-service pricing and excess capacity, are seriously flawed in their failure to treat liner cargo as heterogeneous in unit value. Jansson (1974), for example, argues that excess capacity can be reduced by prohibiting differential pricing. In that way, so it is believed, the service competition among conference members and between conferences and independents will be sharply curtailed. However, it would be extremely difficult to enforce a common rate since such a rate would not reflect the different shippers' costs of using the common service. Even if it were enforced, it would most definitely be discriminatory since some shippers would be required to pay more than their true cost of using the prescribed service while others would pay less. Such pricing schemes cannot exist in perfectly competitive markets. Devanney's (1975) study represents one of the few attempts to account for the shippers' cost of time in transit, but it nevertheless fails to adjust for it fully. A simple average of value per tonne was used with no apparent effort to find a weighted average which reflects each commodity's contribution to total revenue, or to specify a range based upon different unit values.

of such estimates, greater technical efficiency from this source could equal the potential saving from a more complete utilisation of vessels.

Apart from liner administration, the existence of cartels may encourage higher seaman's wages and lower productivity in the on-shore handling of cargo. As before, not all of an estimated excess in input costs can be attributed to conference mismanagement. It is nevertheless convenient to proceed as if it were solely a conference responsibility, and estimate the cost savings attributed to assumed changes in input prices and productivity. The final evaluation can therefore be made to depend upon the extent of the estimated saving.

Data and Results

Estimates of administrative costs in previous simulation studies were based upon conventional liner services which included a substantial degree of on-shore activities by the liner operators. With containership services, these activities were either discontinued or allocated to a separate corporate entity. Our estimate of $900 per day for each containership in 1972-73 represents between four and five per cent of gross revenue. (1) Crew's wages were estimated to be about $700 per day or three per cent of revenue. A one-third reduction in both would therefore result in a saving of about $2 per tonne of 1974-75 cargo.

Despite the fact that terminal operations are regarded as capital intensive, (2) wages and salaries constituted an estimated 57 per cent of operating costs in 1974-75. A one-third reduction in these costs would result in an estimated saving of about $2.40 per tonne. It appears, therefore that a substantial drop in wage and salary costs is needed for both vessel operations and container terminal operations before a significant reduction will result in the average freight rate from Australia to Europe.

Simulating an increase in cargo handling productivity is a more interesting exercise. During 1974-75 the eleven vessels analysed handled 1,389,098 tonnes for 30,868 tonnes per voyage. On the average, 3.59 days were allotted to each Australian port per voyage, compared to 1.57 days in a European port per voyage. Not all of this difference can be attributed to superior productivity in European terminals since it also includes piloting, towing and berthing time. Nevertheless, if it were possible to reduce the time in Australian ports to the European equivalent, 6.85 days could be saved per voyage. In this case the frequency of service can be increased and fewer ships used at existing load factors. The calculations shown in Table 3 indicate that a net saving of $11.68 per tonne of cargo carried is likely to result, and this is nearly the same as the estimated saving in direct transport costs for simulation 1. The latter, however, was incomplete as it did not include the added storage and warehousing costs for the standby cargo. Since no similar costs are involved in this simulation, the overall gain is greater.

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(1) Zerby, Conlon and Kaye (1981b). The conventional and Scandia-type vessels in the same trade were estimated to have experienced a percentage that was much closer to ten per cent.

(2) The term is more popularly applied in a relative sense, indicating that terminal operations are more capital intensive than conventional cargo handling methods.

TABLE 3

ESTIMATED GAIN THROUGH IMPROVED

CARGO HANDLING PRODUCTIVITY

Average days per complete simulated voyage yields	78.18
Average number of voyages per year per vessel	4.68
If average tonnes per voyage per vessel is	30,868.78
then	
Average tonnage per year per visit is	114,117.48
If tonnage per year for the fleet is	1,389,098
then	
Number of vessels required is	9.64
SUBTRACT	
Cost of 1.36 vessels removed @ $6,434,121 per vessel	$8,750,404
Gain to shipper of increased transit time of 6.85 days @ $13,670 per day x 45.12 voyages	$4,225,014
Cost of 6.85 fewer days in port @ $11,041 x 45.12 voyages	$3,412,464
ADD	
Cost of 8.04 additional days at sea per year @ $20,500 per day	$164,879
	$16,223,003
NET GAIN	
PER TONNE OF ASSUMED CARGO	
(exports and imports)	$11.68

Evaluation

Goss (1982) recently suggested that a lack of competition in cargo handling in Australia has contributed to the failure of participating firms to monitor cost and productivity changes and has encouraged the use of questionable accounting practices. A more competitive liner market may have prevented such characteristics from forming, but an immediate injection of competition in liner shipping is unlikely to remove those which currently exist. Moreover, the market for cargo handling services has also been affected by government regulation of waterside employment, by the technological requirements of the container service and by a variety of organisations including the Waterside Workers Federation and the Association of Employers of Waterside Labour. (1)

Shipowners are necessarily concerned with the high cost of delays in cargo handling. They therefore are more willing to agree to requests for higher wages than to risk work stoppages. In some countries a limited amount of competition between ports is apparently sufficient to reduce such risks. It is particularly important to note that the simulated changes adopted here were based upon the productivity in European ports. Since lack of price competition in liner shipping is common to all trades, it cannot explain why European ports are more productive than Australian ports. Therefore, the competitive elements which are needed to achieve the results of this simulation are not restricted solely to liner services.

SIMULATION 3 : CHANGES IN VESSEL SIZE

Introduction

Economies of vessel size arestraightforward. A larger ship is cheaper per tonne of cargo transported at sea, but more expensive in port for a given cargo handling rate. As well, the facilities required for larger ships are generally more expensive, so the largest possible ship is not necessarily optimal. It will be so only if the more costly port installations can be avoided and if port time can be reduced by fast loading and discharging.

A study by Laing (1975) concluded that on the basis of ships' cost only, moderate economies of scale exist in the Australia-Europe trade with vessels of 1200 to 1500 TEUs, with an expected optimum associated with ships having a 1780 to 1820 TEU capacity. The vessels analysed in this study were in the upper part of the first range. Some gains could therefore be achieved with larger vessels, while none can be expected with smaller ones.

Laing's calculations included cargo handling costs, but contained no provision for port changes or cost to the shipper for increases in storage time which would inevitably result from a less frequent service using larger vessels operating at the same speed at sea. Although a large number of simulations are possible, the estimates here will be restricted to a relatively simple experiment with higher-than-average versus lower-than-average cargo.

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(1) Zerby (1982) provides a more complete discussion on the influencing factors.

We shall assume that all cargo with a relatively high value per tonne is transported on 11 containerships having a capacity of 750 TEUs. In this way the frequency of service is unaltered for 50 per cent of the commodities shipped. All cargo with a relatively low value per tonne is carried by 2.75 containerships having a capacity of 3000 TEUs. Voyage frequency is assumed to be reduced to 1 voyage under the new service for every four of the present service.

Data and Results

Laing's calculations indicate that unit operating costs for a 750 TEU vessel are 8.8 per cent higher than one having a 1500 TEU capacity, while the equivalent costs for a 3000 TEU ship are 5.9 per cent lower. Since the smaller vessel's loss exceeds the larger vessel's gain, an equal amount of cargo transferred to the two vessels will necessarily result in a net loss, relative to the 1500 TEU ship. Furthermore, the cost of the extra port visits must be added to the 750 TEU vessel's higher cost, and storage costs must be subtracted from the relative gain of the 3000 TEU ship.

The simulation will produce a net gain only if the separation of cargo into two groups according to value per tonne makes it easier to obtain higher load factors. That is a distinct possibility for the less frequent service for low-valued items, but from simulation 1, it is clear that such an event must also produce an even less frequent service and even higher storage costs.

Evaluation

Shipowners have a limited choice of vessel size and operating speed for the purpose of minimizing costs on a specific route. They may choose incorrectly, either from a wrong assessment of the market or from a desire to "hedge" their corporate planning. In either case, it is difficult to argue convincingly that conferences will necessarily increase the risk of incorrect decisions. If they succeed in stabilising the market, they should reduce the risk.

If an incorrect decision is made, then a liner conference may sustain it. In a highly competitive market, a shipowner employing a sub-optimal fleet of vessels would be driven out of the trade; with conferences, the result is more likely to be higher freight rates. However, if Laing's estimates are correct, a substantial error equal to 50 per cent of the vessel size currently in use will alter the vessel costs per weight unit of cargo by no more than 8.8 per cent.

A more serious problem arises in connection with the size and speed which minimises shipper costs. It is complicated by the fact that shippers will not have the same optimum. If a different quality of service could be provided for each class of shippers displaying similar transit-time preferences, then a competitive market would provide the greatest assurance that an optimum results for each class. Such an arrangement, however, is precluded by the higher unit operating costs of smaller vessels. The simulation with only two groups indicates that a gain is unlikely.

SUMMARY AND CONCLUSION

The allocative inefficiency frequently attributed to liner conferences was approached indirectly by simulating a series of partial optima in service arrangements, estimating the relative gains for each and discussing the ability to achieve the simulated result with a more competitive liner market. The choice of simulated changes was necessarily restricted, but the potential sources of economic waste were included : oversupply of vessel tonnage, overemployment or overpayment of inputs and a limited choice to the shipper of price-and-quality-of-service combinations. For the first two simulations, a greater amount of price and service competition among liner operators would most probably result in a welfare gain, but in neither case is the gain likely to be substantial. For the third simulation, a greater choice of service frequency, speed and vessel itinerary (all at higher prices to shippers) will benefit some shippers, but it is unlikely to benefit all.

The results differ noticeably from the earlier simulation reported by Devanney (1975), which indicated that "the annual cost to the world of the inefficiencies directly attributable to the cartelisation of liner services on this route (West Coast of South America to the US) averages close to $20 per tonne or $40 million per year". (1) Unfortunately, the different estimating procedures preclude a direct comparison of results. Devanney's study was made with reference to conventional shipping services using vessels ranging from 0.5 x 10 cubic feet to 2 x 10 cubic feet bale capacity with speeds ranging from 12 to 22 knots. Containership services brought about a remarkable amount of standardisation among liner operators and substantially narrowed the difference between the most efficient and least efficient operators. Moreover, Devanney assumed that time in port is not a function of the amount of cargo loaded (2) and included no allowance for additional storage costs associated with a less frequent service.(3) It is not possible to adjust Devanney's estimates for the differences, but it is clear that if such adjustments were possible they would tend to reduce the cost of the "inefficient" Latin American service which he studied.

A major limitation of cost simulations is the necessity of using data relating to a specific year, and therefore reflecting circumstances which are not likely to be repeated. Since 1974-75, the decline in the volume of trade and the failure to achieve improved rates of loading and discharging have made the use of 3000 TEU vessels on the Australia-Europe trade less feasible than was conceived in the early 1970s. Similarly, the recent drop in exports to Europe, relative to imports, has increased the existing disparity in cargo flows so that it is now even less realistic to concentrate on the elimination of excess capacity on Australia-outward voyages. It should be noted, however, that the purpose of the simulations was to look at relative magnitudes, not to select or defend a service optimum. The 1974-75 service could have been improved, but if it had been made more optimal in that year, the gain in allocative efficiency would not have been substantial.

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(1) Devanney (1975), p. 176.

(2) The assumption was based upon the finding that time in port is a "rather weak function of the amount of cargo loaded or unloaded. This is a result of the rather large 'set-up' times entailed in entering and leaving port, together with the generally small amounts of cargo handled". Devanney (1975), p.7.

(3) Devanney (1975), p.174.

Throughout the discussion it was assumed that any welfare gain could be achieved only by a more competitive liner market. The assumption was made for the purpose of establishing the maximum amount of allocative inefficiency which can be attributed to conferences. It clearly overstates the "true" amount. A careful apportioning of the 1974-75 inefficiency is beyond the scope of this paper. It is nevertheless important to emphasise that the largest gain in the simulations was associated with an increase in cargo handling productivity, which will not necessarily be achieved by a more competitive liner market and failure to achieve it cannot be attributed solely to liner conferences.

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